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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/553,677	10/17/2005	Shuichi Okawa	125685	1829
25944	7590	10/04/2007		
OLIFF & BERRIDGE, PLC P.O. BOX 19928 ALEXANDRIA, VA 22320			EXAMINER DAHIMENE, MAHMOUD	
			ART UNIT 1765	PAPER NUMBER
			MAIL DATE 10/04/2007	DELIVERY MODE PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

10/553,677

Applicant(s)

OKAWA ET AL.

Examiner

Mahmoud Dahimene

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 15 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date <u>10/17/2005</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 2, 4, 7, 16, are rejected under 35 U.S.C. 103(a) as being unpatentable over Dalton et al. (US 2003/0134505).

Dalton discloses a method of forming an etch pattern comprising the steps of:  
A mask material (TaSiN) (paragraph 0021) for reactive ion etching that uses carbon monoxide gas and nitrogen-containing compound NH<sub>3</sub> (paragraph 0024),  
the mask material for reactive ion etching characterized by containing silicon and tantalum. Dalton clearly suggest a chemistry including CO and NH<sub>3</sub>.

It is noted that Dalton does not expressly disclose the gas mixture as a carbon monoxide gas, to which a nitrogen-containing compound gas is added, as a reactive gas, however, it would have been obvious to one of ordinary skill in the art at the time the invention was made to expect the hydrogen released from the  $\text{NH}_3$  by the plasma to react with at least on surface exposed by the mask layer (20).

***Claim Rejections - 35 USC § 103***

4. Claims 3, 11, 12, 13, 17, are rejected under 35 U.S.C. 103(a) as being unpatentable over Dalton et al. (US 2003/0134505) as applied to claims 1, 2, above, in view of Gutsche (US 2002/0173163).

5. It is noted that Dalton is silent about a layered mask as described in applicant's claims 3, 11, 12, 13.

Gutsche discloses a multilayered hardmask wherein the first hard mask layer and the plurality of the further hard mask layers include materials selected from the group consisting of silicon, silicon oxide, a borosilicate glass, a borophosphorus silicate glass, a flowable oxide, **SiN**, **SiO.sub.xN.sub.y**, W, Wsi, Ti, TiN, TiSi, Al, Cu, **Ta**, **TaN**, a polyimide, a photoresist, and a metal oxide (claim 7).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Dalton to add a second hard mask layer including the materials SiN or SiO.sub.xN.sub.y because Gutsche teaches multi-layered hard masks are conventionally used in semiconductor manufacturing. One of ordinary skill in the art would have been motivated to add a second hard mask layer including the

materials SiN or SiO<sub>x</sub>N<sub>y</sub> in order to provide an improved method for fabricating a hard mask having a larger thickness or an increased etching resistance. The method makes it possible to realize etchings that are no longer possible by the application of a simple customary hard mask, as suggested by Gutsche. For example Gutsche's method allows etching higher aspect ratio features or more vertical etch profiles, which are highly desirable as the etched features are getting smaller driven by higher device integration requirements.

***Claim Rejections - 35 USC § 103***

6. Claims 5, 6, 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dalton et al. (US 2003/0134505) as applied to claims 1, 2, above, in view of Grill et al. (Journal of Material Research, Vol. 14, No. 4, (1999), pages 1604-1609).

It is noted that Dalton is silent about the Si or Ta content of the TaSiN mask.

Grill teaches TaSiN films display resistance to oxidation. Grill cites sample TSN1 and TSN2 have (Si/Si+Ta) ratios of 15.4% and 35.7% respectively (Table III). After annealing for up to 30 min at 650 C or up to 5 min at 700 C. Grill discloses TSN2 sample oxidized much less than samples TSN1 (page 1607, column 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Dalton to select the (Si/Si+Ta) ratios in any range disclosed by Grill including more than 0% and 50% or less, or more than 10% and 30% or less depending on the oxidizing condition caused by the oxygen in the etching plasma, because Grill teaches the basic concept of selecting resistance to

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oxidation based on the TaSiN material Ta:Si:N content, and since it has been held that the provision of adjustability, where needed, involves only routine skill in the art.

***Claim Rejections - 35 USC § 103***

7. Claims 8, 9, 10, 18, 20, are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakatani et al. (US 2002/0033681) in view of Dalton et al. (US 2003/0134505) and Grill et al. (Journal of Material Research, Vol. 14, No. 4, (1999), pages 1604-1609).

Nakatani discloses a dry etching method characterized by including: a mask forming step of forming a mask layer comprising a mask material for reactive ion etching in a predetermined pattern on an object to be processed; and an object processing step for processing the object to be processed in a shape of the pattern through the use of reactive ion etching that uses carbon monoxide gas, to which a nitrogen-containing compound gas is added, as a reactive gas (figure 6(C)) (paragraph 0019).

It is noted that Nakatani does not expressly disclose the mask material for reactive ion etching as set forth in claim 1.

The reference of Dalton, discussed above, teaches TaSiN masks accomplish the same function as Ta masks (paragraph 0021) as far as resistance to CO and NH<sub>3</sub> (or combination of both) plasmas.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Nakatani by using TaSiN instead

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of the Ta mask because teaches TaSiN masks accomplish the same function as Ta masks. One of ordinary skill in the art would have been motivated to modify the process of Nakatani by using TaSiN instead of the Ta in order to obtain a mask which is less susceptible to oxidize in an oxygen containing gas plasma, since oxidation might deteriorate or damage the mask which is not desirable for etching smaller feature.

***Claim Rejections - 35 USC § 103***

8. Claims 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dalton et al. (US 2003/0134505) as applied to claims 1, 2, above, in view of Gutsche (US 2002/0173163) and further in view of Grill et al. (Journal of Material Research, Vol. 14, No. 4, (1999), pages 1604-1609).

It is noted that Dalton is silent about the Si or Ta content of the TaSiN mask.

Grill teaches TaSiN films display resistance to oxidation. Grill cites sample TSN1 and TSN2 have (Si/Si+Ta) ratios of 15.4% and 35.7% respectively (Table III). After annealing for up to 30 min at 650 C or up to 5 min at 700 C. Grill discloses TSN2 sample oxidized much less than samples TSN1 (page 1607, column 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Dalton to select the (Si/Si+Ta) ratios in any range disclosed by Grill including more than 0% and 50% or less, or more than 10% and 30% or less depending on the oxidizing condition caused by the oxygen in the etching plasma, because Grill teaches the basic concept of selecting resistance to

oxidation based on the TaSiN material Ta:Si:N content, and since it has been held that the provision of adjustability, where needed, involves only routine skill in the art.

***Claim Rejections - 35 USC § 103***

9. Claim 19 rejected under 35 U.S.C. 103(a) as being unpatentable over Nakatani et al. (US 2002/0033681) in view of Dalton et al. (US 2003/0134505) and Grill et al. (Journal of Material Research, Vol. 14, No. 4, (1999), pages 1604-1609) and further in view of Gutsche (US 2002/0173163).

10. It is noted that Nakatani is silent about a layered mask as described in applicant's claims 3.

The references of Dalton and Grill have been discussed above.

Gutsche discloses a multilayered hardmask wherein the first hard mask layer and the plurality of the further hard mask layers include materials selected from the group consisting of silicon, silicon oxide, a borosilicate glass, a borophosphorus silicate glass, a flowable oxide, **SiN**, **SiO.sub.xN.sub.y**, W, Wsi, Ti, TiN, TiSi, Al, Cu, **Ta**, **TaN**, a polyimide, a photoresist, and a metal oxide (claim 7).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Nakatani to add a second hard mask layer including the materials SiN or SiO.sub.xN.sub.y because Gutsche teaches multi-layered hard masks are conventionally used in semiconductor manufacturing. One of ordinary skill in the art would have been motivated to add a second hard mask layer including the materials SiN or SiO.sub.xN.sub.y in order to provide an improved method



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for fabricating a hard mask having a larger thickness or an increased etching resistance.

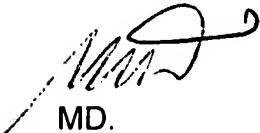
The method makes it possible to realize etchings that are no longer possible by the application of a simple customary hard mask, as suggested by Gutsche. For example Gutsche's method allows etching higher aspect ratio features or more vertical etch profiles, which are highly desirable as the etched features are getting smaller driven by higher device integration requirements.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mahmoud Dahimene whose telephone number is (571) 272-2410. The examiner can normally be reached on week days from 8:00 AM. to 5:00 PM..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



MD.

NADINE G. NORTON  
SUPERVISORY PATENT EXAMINER

